



University of  
Massachusetts  
Amherst

## Session D1: Towards Effective, Bi- Directional Selective Fish Passage

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# Bi-directional, Selective Fish Passage: The Complications of Fish Passage in the Laurentian Great Lakes



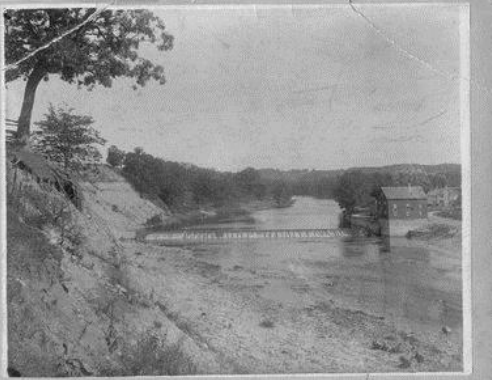
Tom Pratt, Fisheries and Oceans Canada

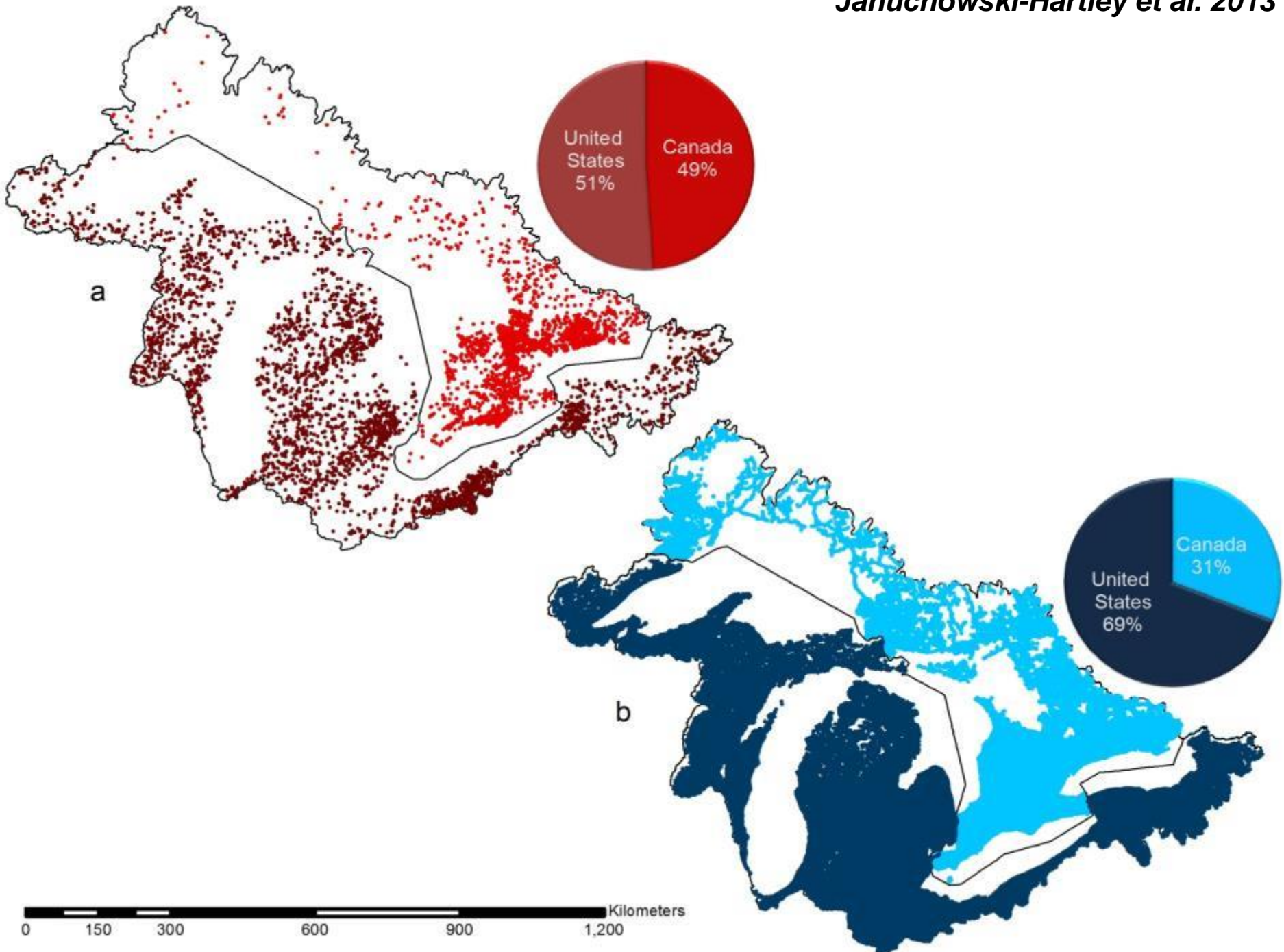
Rob McLaughlin, University of Guelph

Andrew Muir, Great Lakes Fishery Commission

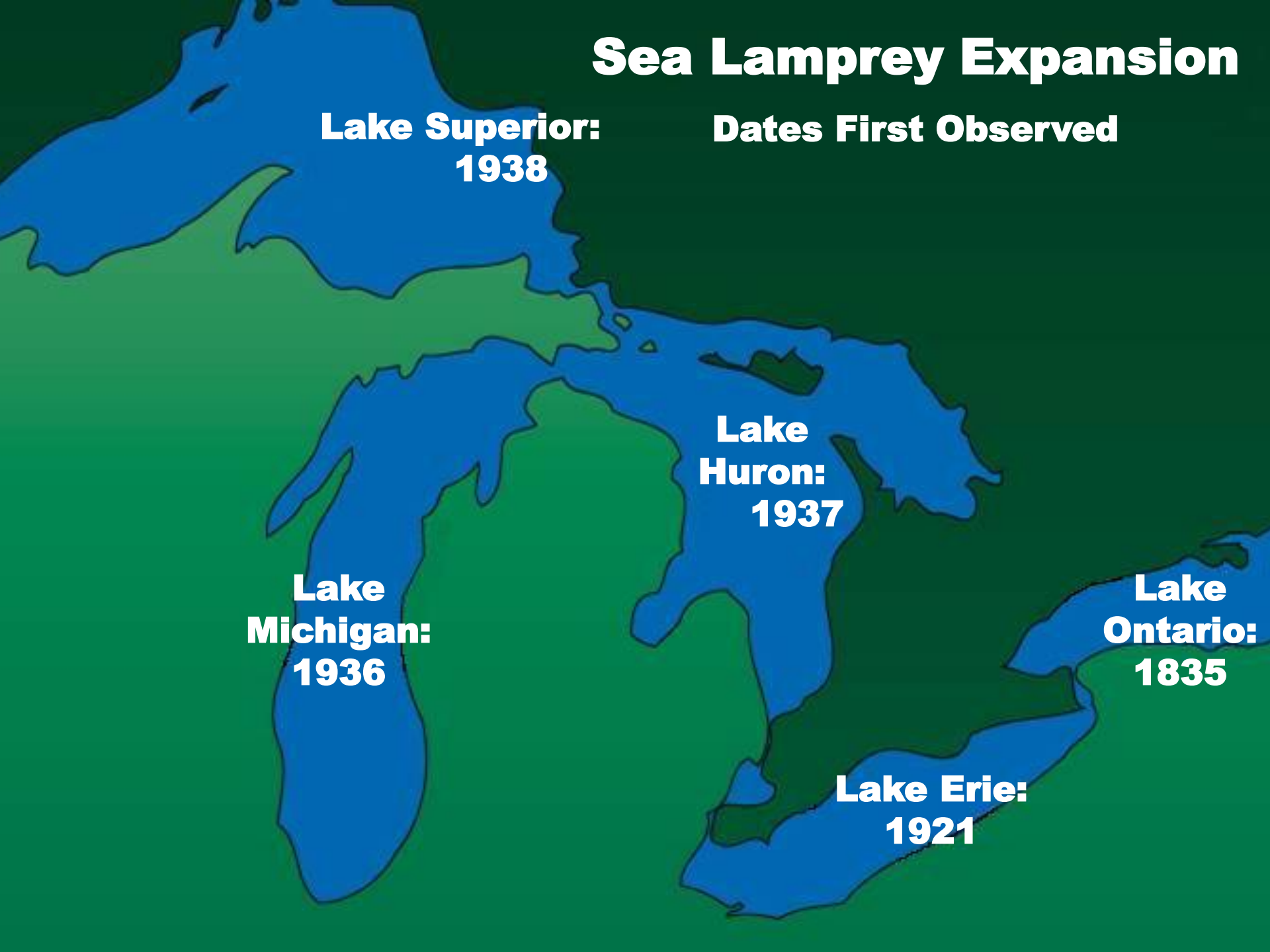
# A Brief History of Barriers

- Milling, mining and forestry
- Water regulation, recreation and hydroelectric power generation
- Control of invasive species





# Sea Lamprey Expansion



## Dates First Observed

**Lake Superior:  
1938**

**Lake  
Huron:  
1937**

**Lake  
Michigan:  
1936**

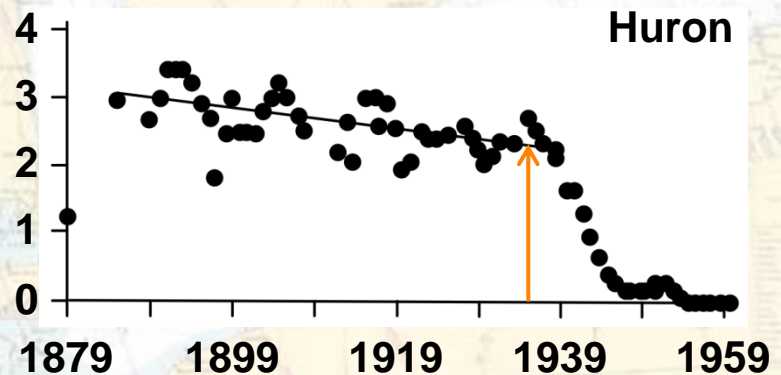
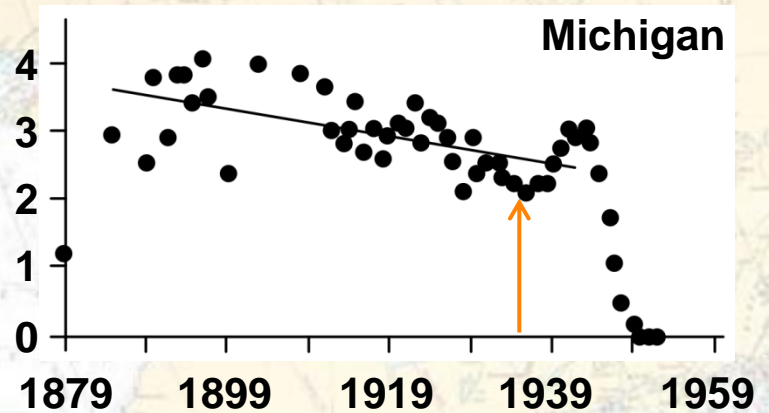
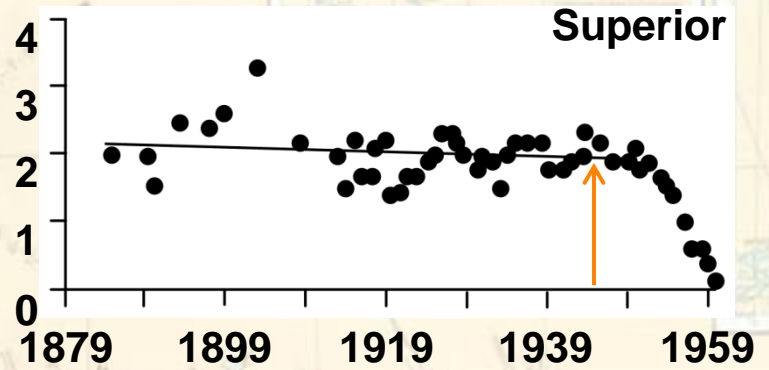
**Lake  
Ontario:  
1835**

**Lake Erie:  
1921**



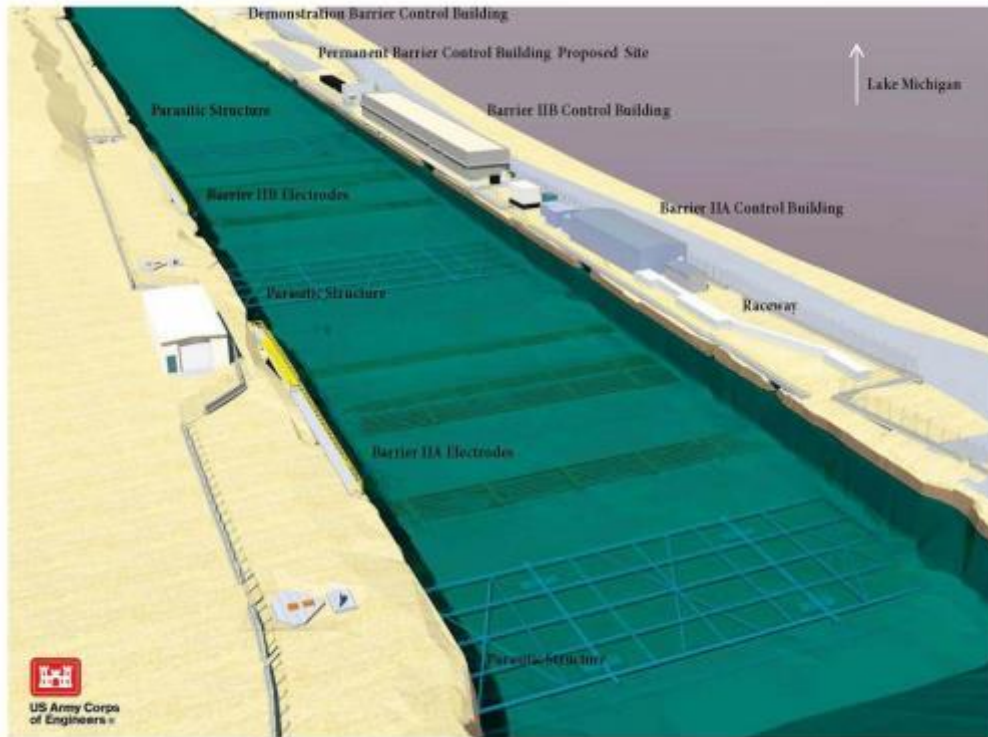
- Sea lampreys helped decimate Great Lakes fish populations
- Barriers are an integral component of a \$21MM annual binational sea lamprey control effort

commercial catch of lake trout  
(millions of kg)



Hansen, M.J. 1999. Great Lakes Fishery Policy and Management - a Binational Perspective.

# Asian Carp on the Horizon



- Electrical barrier keeping Asian carp out of the Great Lakes



**Black Sturgeon**

**\$1.6M**

# Increasing Pressure for Dam Removals

**Manistique**

**\$0.8M**

**\$1.0M**

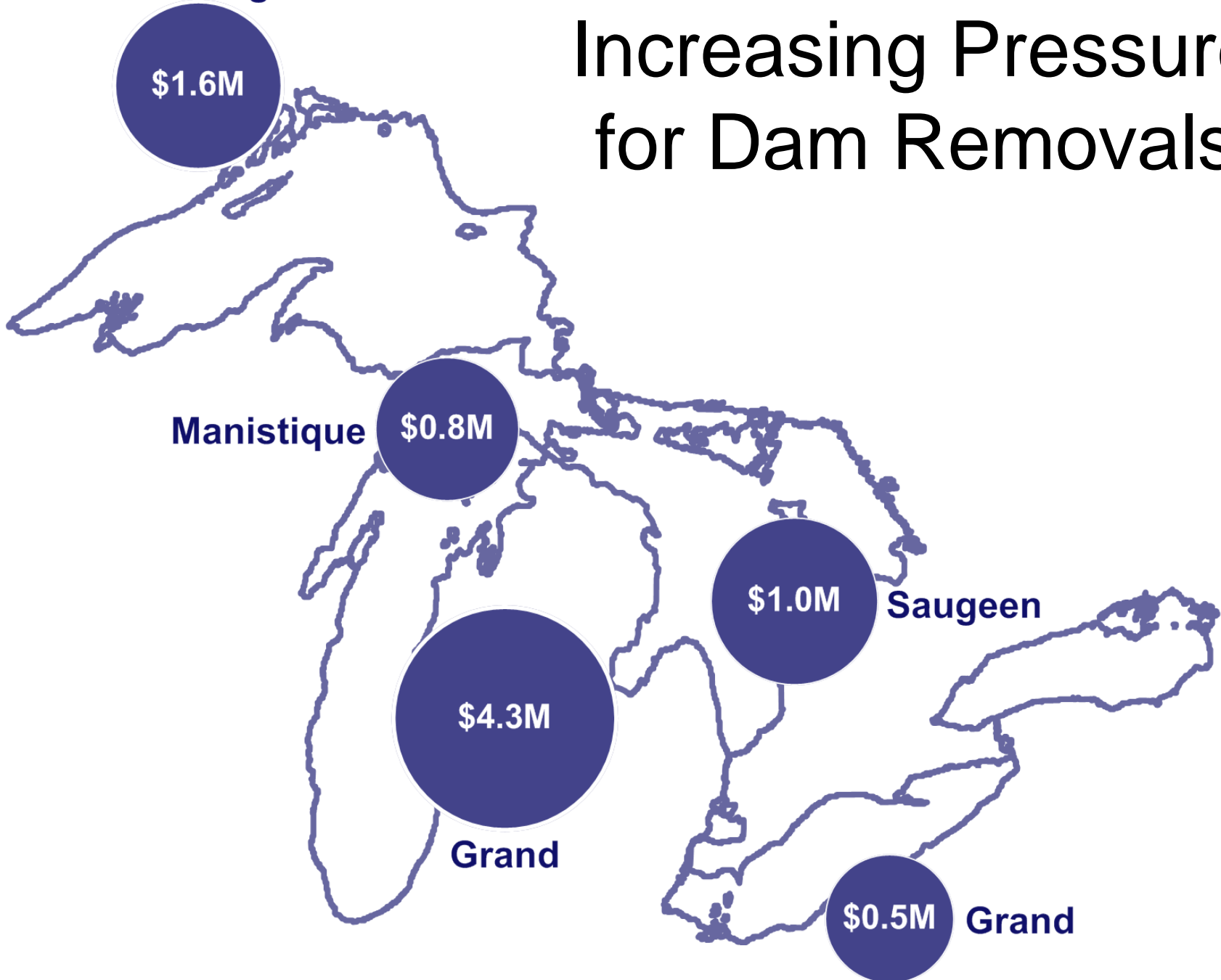
**Saugeen**

**\$4.3M**

**Grand**

**\$0.5M**

**Grand**





# Management Challenge

## INVASIVE CONTROL vs RESTORATION



## FRAGMENTATION vs CONNECTIVITY



ANDY MASER FILMS

GENERAL CHART  
OF THE  
GREAT LAKES

# Research Goal

- Provide bi-directional movement of desirable fishes through and removal of invasive fishes in fragmented watersheds

**INSIGHTS** Precision medicine comes to psychiatry p. 46  
Secure sustainable seafood from developing countries p. 48

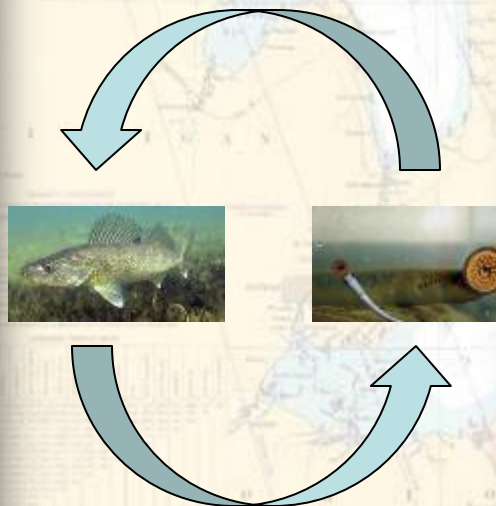
**PERSPECTIVES**

**ECOLOGY**  
**1000 dams down and counting**  
Dams retrofits are reconnecting rivers in the United States  
By J. B. Griffith, J. B. Griffith, G. B. Griffith



For over a century, the construction of large dams was mostly unopposed, and the United States is now the world's largest dam-building nation. The United States is now the world's largest dam-building nation. The United States is now the world's largest dam-building nation. The United States is now the world's largest dam-building nation.

**Keynote by George B. Griffith** (with George B. Griffith, J. B. Griffith, G. B. Griffith)



**FISH and FISHERIES**

FISH and FISHERIES, 2012, 54, 500-508

**Unintended consequences and trade-offs of fish passage**

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**Abstract**  
We synthesized evidence for unintended consequences and trade-offs associated with the passage of fishes. Prescreening of fish passage at dams and dam retrofits are being carried out increasingly as resource managers seek ways to reduce fragmentation of migratory fish populations and restore biodiversity and nature-like ecosystem services to tributaries altered by dams. The benefits of protecting upstream passage are highlighted widely. Possible associated consequences and trade-offs of upstream passage are coming to light, but remain poorly quantified and underappreciated. Unintended consequences arise when passage of native and desirable introduced fishes is delayed, and/or fish pass in patterns of movement and habitat use that reduce their fitness (e.g., ecological traps, or highly selective, seasonally and seasonally, trade-offs arise when passage decisions intended to benefit native species interact with management decisions intended to control the unwanted spread of non-native fishes and aquatic vertebrates, or genes, diseases and contaminants carried by hatchery and wild fish. These consequences and trade-offs will vary in importance from system to system and can result in large economic and environmental costs. For some river systems, decisions about how to manage fish passage involve substantial risks and could benefit from use of a formal, structured process that allows management, scientific, and where possible, quantitative evaluation of these risks. Such a process not only facilitates the design of an adaptive framework, but provides valuable insights into future decisions.

**Keywords** Dam removal, fish passage, migration, risk, structured decision-making, trade-offs

# Project Objectives

1. Develop selective bi-directional fish sorting technology as an adaptive management experiment
2. Determine protocols for implementing bi-directional selective fish passage throughout the Great Lakes Basin
3. Set solutions in a global context

# How to sort an assortment of things?

## HOW IT WORKS

STORY BY KATIE PEER

ILLUSTRATION BY GRAHAM MURDOCH

## SINGLE-STREAM RECYCLING

**T**he most annoying aspect of recycling—and one of the biggest hurdles to its widespread adoption—is having to separate paper, glass, and plastic before they hit the curb. New recycling machines are changing that. With single-stream recycling, recyclables go into one bin, which a truck delivers to a materials-recovery facility, such as Willimantic Waste

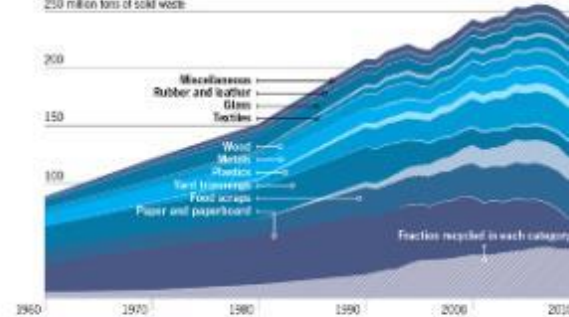
Paper in Willimantic, Connecticut. There, a largely automated system of conveyor belts, screens, magnets, and lasers separates materials so that they can be sold to metal and plastic recyclers and paper mills.

Of the 570 recycling facilities in the U.S., 240 now have single-stream operations, according to Eileen Beery, of the solid-waste research and consulting firm Governmental

Advisory Associates. While the system isn't perfect—its high-speed operation can lead to contamination from broken glass—the simplicity of it means households actually recycle more. "If people want a higher recycling rate, it has to be convenient," says Chaz Miller, of the National Solid Wastes Management Association. "And I think the technology is only going to improve."

### Recycling Rates in the U.S.

250 million tons of solid waste



### STATS

**2.4**

Tons of carbon dioxide left out of the atmosphere per ton of solid waste recycled, whether by single-stream or otherwise.

**One third**

Fraction of municipal solid waste in the U.S. that's currently recycled.

**100 million**

Number of U.S. residents served by single-stream recycling programs.

**92**

Percentage recycling rates increased when Florida's Miami-Dade County implemented single-stream recycling in 2008.



- |               |             |                 |                    |                |              |              |                       |                        |                 |       |          |
|---------------|-------------|-----------------|--------------------|----------------|--------------|--------------|-----------------------|------------------------|-----------------|-------|----------|
| 1             | 2           | 3               | 4                  | 5              | 6            | 7            | 8                     | 9                      | 10              | 11    | 12       |
| Tipping Floor | Drum Feeder | Initial Sorters | Large Star Screens | Second Sorters | Star Screens | Glass Sorter | Magnetic Metal Sorter | Eddy Current Separator | Infrared lasers | Baler | Landfill |

INSET COURTESY LIBBY LUBELLA, HANDBY RECYCLING SOLUTIONS

# Integrating Technologies

**Electr**



**Chemical repellants**

**P**

# Integrating Technologies



U.S. Fish & Wildlife Service

## Yukon River Video Project

Fairbanks Fish & Wildlife Field Office

Fish wheels are commonly used as a capture method to determine relative abundance and run timing of Yukon River salmon. These "test wheel" catch rates are used by fishery managers to assess the in-season salmon runs on a daily basis. The wheels use live boxes to store fish until they are counted by dip netting. Recent studies on Yukon River fall chum salmon suggest that holding time and crowding in live boxes may affect the ability of fish to travel upstream to spawning streams. This is of particular concern during years of low salmon abundance.

A remote video system was developed to obtain salmon passage rates without the use of fish wheel live boxes, eliminating fish handling and crowding concerns. After fish wheel capture, fish travel down a chute, are video recorded, and then re-enter the river. The system consists of a color CCD camera mounted above the fish wheel chute and connected



*This video system continuously records fish passing through the fishwheel and captures the information on a laptop for later analysis.*

to a laptop computer through a video capture card. A time-lapse VCR is linked into the system for back-up. The system is powered by 12 volt batteries. During daytime operation, a water-wheel generator charges the batteries. At night, lights necessitate the use of a small gasoline generator.

Video capture software allows the recording of only video frames containing fish images. These images are stored in computer video files. Video capture can be triggered using various methods i.e. magnetic switch door, motion sensor, and image recognition. Frame rate and number of frames captured before or after a triggering event are controlled by the software. The resulting files are reviewed and tallied using video reviewing software specifically de-

signed for generating fisheries Catch Per Unit Effort data. The time-savings using this method over traditional viewing of time-lapse VCR tapes can be substantial.

Presently, three Yukon River fish wheels are equipped with this video system. Accurate daily counts of four salmon species, sheefish, whitefish, and various resident fish species are obtained using the video system. The benefits of video counting are a lowering of fish stress, 24 hour sampling, reduced data recording errors, and lower operational costs. Other applications of this technology include monitoring fish passage at dams and weirs, identification of marked/unmarked fish in tagging studies, and remote monitoring of animal behavior.



*The video capture program allows easy identification of the species of fish and whether or not it is tagged.*

U.S. Fish & Wildlife Service  
1 800/344 WILD  
[www.fws.gov](http://www.fws.gov)

For more information, contact:  
U.S. Fish & Wildlife Service  
Dave Daum  
101 12th. Ave., Room 110, Fairbanks, Alaska 99701  
907/450/0280

Visit the Fisheries & Habitat home page:  
<http://alaska.fws.gov/fisheries/fieldoffice/http://fairbanks/monitoring.htm>

- Shape recognition
- Behavioral recognition
- Color identification
- Enumeration

# Conceptual Approach Integrating Technologies

Upstream Electrical Guidance

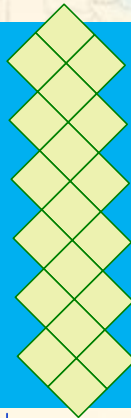


Life History

- Seasonal
- Diel

# Conceptual Approach Integrating Technologies

Upstream Electrical Guidance



Life History

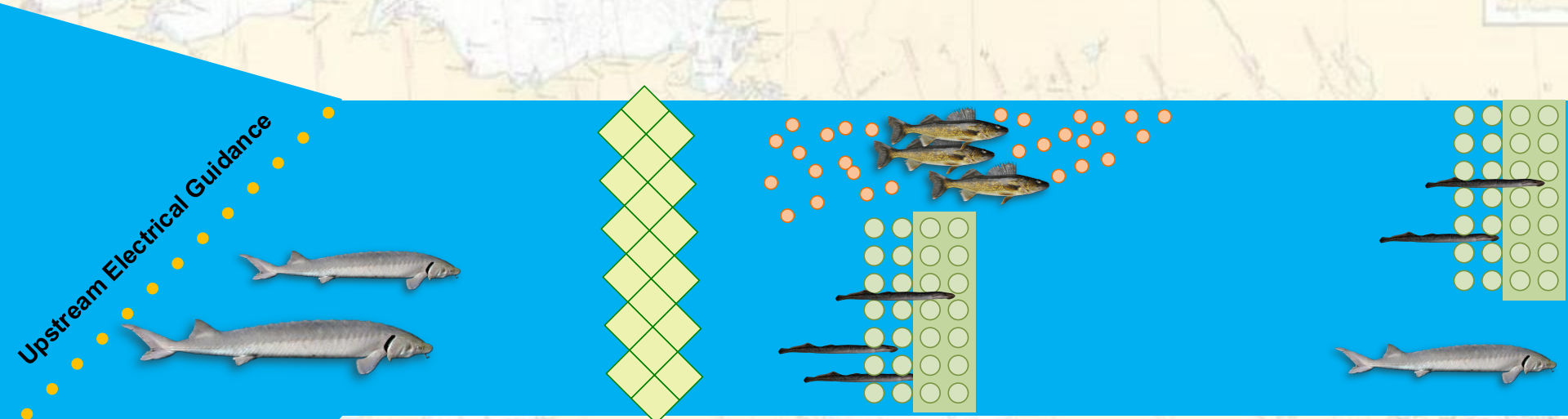
- Seasonal
- Diel

Morphology

- Video shape recognition
- Elevators
- Screens
- Ladders



# Conceptual Approach Integrating Technologies



## Life History

- Seasonal
- Diel

## Morphology

- Video shape recognition
- Elevators
- Screens
- Ladders

## Behaviour

- ELST
- Funnel
- Novel
- Pheromones
- Alarm cues
- Co<sub>2</sub> curtain

- If you have any experience in this area (or ideas) we would love to hear from you:

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Andrew Muir:

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KEEP CALM

BECAUSE

WE NEED

YOUR

HELP!